Candidate Name	Centre Number	Candidate Number
		0

General Certificate of Secondary Education

240/02

ADDITIONAL SCIENCE
HIGHER TIER (Grades D-A*)
CHEMISTRY 2

P.M. FRIDAY, 18 January 2008

(45 minutes)

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**8**	
2.	**7**	
3.	**8**	
4.	**6**	
5.	**6**	
6.	**8**	
7.	**7**	
Total	**50**	

ADDITIONAL MATERIALS

In addition to this paper you may require a calculator and a ruler.

INSTRUCTIONS TO CANDIDATES

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question.

You are reminded of the necessity for good English and orderly presentation in your answers.

The Periodic Table is printed on the back cover of the examination paper and the formulae for some common ions on the inside of the back cover.

No certificate will be awarded to a candidate detected in any unfair practice during the examination.

Examiner only

Answer **all** *questions.*

1. *(a)* Ammonia is made from nitrogen and hydrogen by the Haber process.

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$$

(i) State where the nitrogen used in this reaction comes from. [1]

....

(ii) State what is meant by the term ***reversible reaction***. [1]

....

....

(b) One of the main uses of ammonia is in the production of nitrogenous fertilisers. The table below shows the content of three types of fertiliser.

	Percentage present			
Fertiliser	*Nitrogen*	*Phosphate*	*Potash*	*Sulphur*
A	34	0	0	0
B	21	0	0	24
C	0	0	52	12

(i) State which fertiliser, **A**, **B** or **C**, is not made from ammonia. Give a reason for your answer. [2]

Fertiliser ....

Reason ....

(ii) One of the fertilisers, **A B** or **C**, is produced when ammonia is neutralised by sulphuric acid.

I. Give the letter of the fertiliser produced in this way and a reason for your answer. [2]

Fertiliser ....

Reason ....

II. Give a **word** equation for the reaction taking place when ammonia solution is neutralised by sulphuric acid. [2]

....

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2. *(a)* The following diagram shows part of the Reactivity Series.

Potassium
Sodium
Magnesium
Aluminium
(Carbon)
Zinc
Iron
Tin
Lead
Copper
Silver
Gold

↓ Reactivity decreasing

(i) Use the Reactivity Series above to explain why iron can be extracted from its ore, iron oxide, by heating with carbon. [2]

....

....

(ii) Aluminium is extracted using electrolysis rather than chemical reduction. Explain why chemical reduction with carbon is not possible. [1]

....

....

(b) (i) The cost of electricity for producing 1 tonne of aluminium from its ore is £2100. Recycling aluminium uses only 5% of the electricity needed to extract it.

Calculate the cost of electricity needed to recycle 1 tonne of aluminium. [1]

Cost = £ ....

(ii) Apart from saving energy, give **one** other reason for recycling being better for the environment than extracting aluminium from its ore. [1]

....

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(c) The table below shows what is needed for the extraction of one tonne of iron. The cost of one tonne of each material is also shown.

Raw materials	*Amount needed* / tonnes	*Cost per tonne* / £
iron ore	2	40
coke	1	152
limestone	0·5	90
hot air	4	2

Calculate the cost of producing one tonne of iron. [2]

Cost of one tonne = £ ....

7

Turn over.

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3. The following table shows information about the atoms of some elements.

The Periodic Table of Elements shown on the **back cover of this examination paper** may be of help in answering this question.

Element	*Symbol*	*Number of protons*	*Number of neutrons*	*Number of electrons*
sodium	$^{23}_{11}Na$	11	12	11
boron	$^{11}_{5}B$	....	6	....
magnesium	$^{24}_{12}Mg$	12	....	12
....	....	10	10	10

(i) Complete the table above. [5]

(ii) Electrons have a charge of –1. In a similar way, give the charge present on

I. a proton, ... [1]

II. a neutron. .... [1]

(iii) Use this information, together with the table in (i) above, to explain why an atom has no overall charge. [1]

....

....

8

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4. Scientists have developed a range of new materials known as smart materials.

(i) State what is meant by a ***smart material***. [2]

....

....

(ii) State why each of the following is considered to be a smart material:

I. thermochromic paint; [2]

....

....

II. shape memory alloy. [2]

....

....

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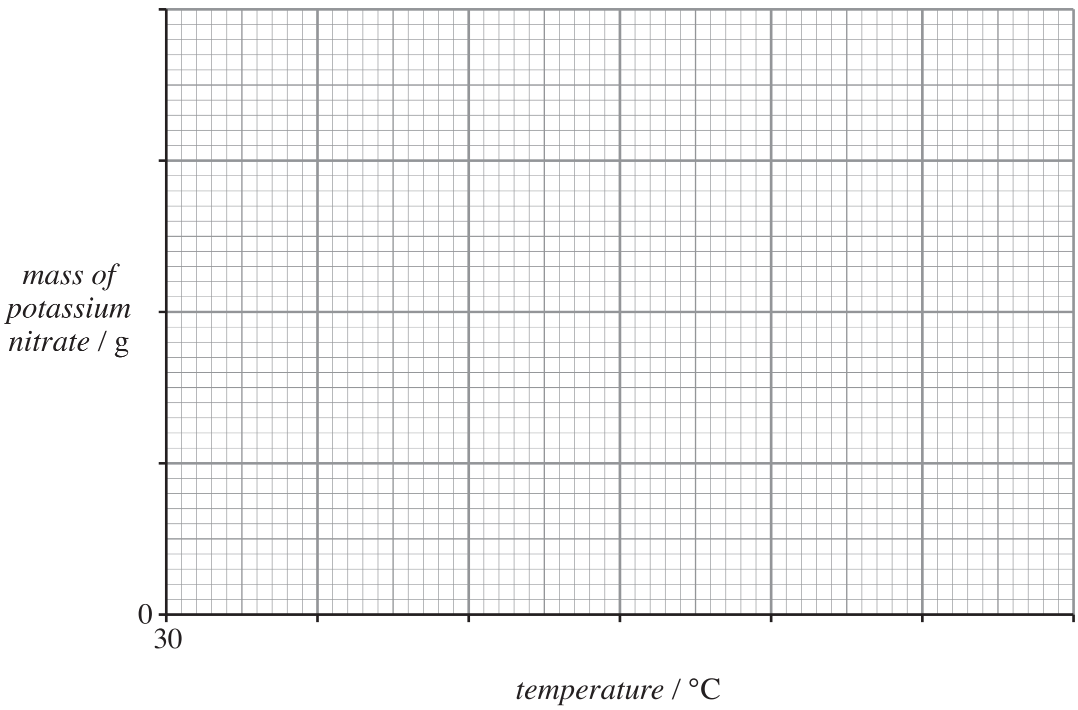
5. Different masses of potassium nitrate were dissolved in **20 cm^3** of hot water. The water was allowed to cool slowly and the temperature at which crystals appeared was noted. The results obtained are shown below.

mass of potassium nitrate / g	10	15	20	25	30	35
temperature at which crystals appear / °C	33	46	57	65	73	80

(i) Draw a graph using the above data. [4]



(ii) Using your graph, predict the mass of potassium nitrate that dissolves in **100 cm^3** of water at 70 °C. [2]

....

....

....

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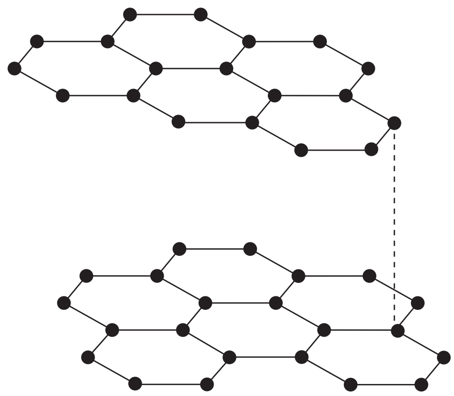
6. *(a)* Potassium reacts with chlorine to form potassium chloride. Using the electronic structures given below, show the electronic changes that take place during the formation of potassium chloride. Include the charges on the ions formed. [4]

Potassium = 2,8,8,1 Chlorine = 2,8,7

(b) (i) The following diagram shows the structure of graphite.



Explain why graphite

I. is a good electrical conductor, [1]

....

....

II. can be used as a lubricant. [1]

....

....

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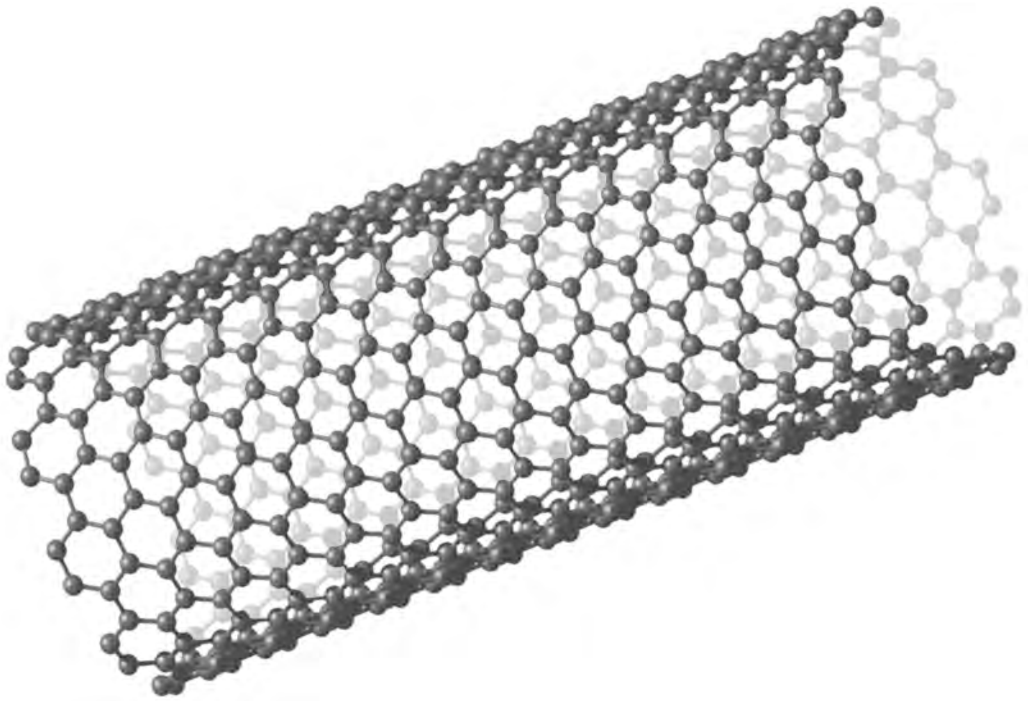
(ii) Scientists are investigating the properties and potential uses of the structure shown below.



I. Name this structure. [1]

....

II. Give a potential use for this structure. [1]

....

8

Turn over.

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7. Iron is extracted from its ore in the blast furnace. The equation for one of the reactions taking place is shown below.

$$Fe_2O_3(s) + 3C(s) \longrightarrow 2Fe(s) + 3CO(g)$$

(i) Use the equation above to calculate the mass of iron that would be formed from 240 tonnes of iron(III) oxide. [3]

A_r (Fe) = 56; A_r (O) = 16; A_r (C) = 12.

....

....

....

....

(ii) The above reaction would also use 54 tonnes of carbon in order to produce the amount of iron formed in (i).

I. Calculate the total mass of reactants used. [1]

....

....

II. Using this figure, calculate the atom economy of the reaction. [2]

....

....

....

III. Why is it important for a reaction to have a high atom economy? [1]

....

....

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FORMULAE FOR SOME COMMON IONS

POSITIVE IONS		NEGATIVE IONS	
Name	**Formula**	**Name**	**Formula**
Aluminium	Al^{3+}	Bromide	Br^{-}
Ammonium	NH_4^{+}	Carbonate	CO_3^{2-}
Barium	Ba^{2+}	Chloride	Cl^{-}
Calcium	Ca^{2+}	Fluoride	F^{-}
Copper(II)	Cu^{2+}	Hydroxide	OH^{-}
Hydrogen	H^{+}	Iodide	I^{-}
Iron(II)	Fe^{2+}	Nitrate	NO_3^{-}
Iron(III)	Fe^{3+}	Oxide	O^{2-}
Lithium	Li^{+}	Sulphate	SO_4^{2-}
Magnesium	Mg^{2+}		
Nickel	Ni^{2+}		
Potassium	K^{+}		
Silver	Ag^{+}		
Sodium	Na^{+}		

PERIODIC TABLE OF ELEMENTS

1	2					Group						3	4	5	6	7	0
								$^{1}_{1}$H Hydrogen									$^{4}_{2}$He Helium
$^{7}_{3}$Li Lithium	$^{9}_{4}$Be Beryllium											$^{11}_{5}$B Boron	$^{12}_{6}$C Carbon	$^{14}_{7}$N Nitrogen	$^{16}_{8}$O Oxygen	$^{19}_{9}$F Fluorine	$^{20}_{10}$Ne Neon
$^{23}_{11}$Na Sodium	$^{24}_{12}$Mg Magnesium											$^{27}_{13}$Al Aluminium	$^{28}_{14}$Si Silicon	$^{31}_{15}$P Phosphorus	$^{32}_{16}$S Sulphur	$^{35}_{17}$Cl Chlorine	$^{40}_{18}$Ar Argon
$^{39}_{19}$K Potassium	$^{40}_{20}$Ca Calcium	$^{45}_{21}$Sc Scandium	$^{48}_{22}$Ti Titanium	$^{51}_{23}$V Vanadium	$^{52}_{24}$Cr Chromium	$^{55}_{25}$Mn Manganese	$^{56}_{26}$Fe Iron	$^{59}_{27}$Co Cobalt	$^{59}_{28}$Ni Nickel	$^{64}_{29}$Cu Copper	$^{65}_{30}$Zn Zinc	$^{70}_{31}$Ga Gallium	$^{73}_{32}$Ge Germanium	$^{75}_{33}$As Arsenic	$^{79}_{34}$Se Selenium	$^{80}_{35}$Br Bromine	$^{84}_{36}$Kr Krypton
$^{86}_{37}$Rb Rubidium	$^{88}_{38}$Sr Strontium	$^{89}_{39}$Y Yttrium	$^{91}_{40}$Zr Zirconium	$^{93}_{41}$Nb Niobium	$^{96}_{42}$Mo Molybdenum	$^{99}_{43}$Tc Technetium	$^{101}_{44}$Ru Ruthenium	$^{103}_{45}$Rh Rhodium	$^{106}_{46}$Pd Palladium	$^{108}_{47}$Ag Silver	$^{112}_{48}$Cd Cadmium	$^{115}_{49}$In Indium	$^{119}_{50}$Sn Tin	$^{122}_{51}$Sb Antimony	$^{128}_{52}$Te Tellurium	$^{127}_{53}$I Iodine	$^{131}_{54}$Xe Xenon
$^{133}_{55}$Cs Caesium	$^{137}_{56}$Ba Barium	$^{139}_{57}$La Lanthanum	$^{179}_{72}$Hf Hafnium	$^{181}_{73}$Ta Tantalum	$^{184}_{74}$W Tungsten	$^{186}_{75}$Re Rhenium	$^{190}_{76}$Os Osmium	$^{192}_{77}$Ir Iridium	$^{195}_{78}$Pt Platinum	$^{197}_{79}$Au Gold	$^{201}_{80}$Hg Mercury	$^{204}_{81}$Tl Thallium	$^{207}_{82}$Pb Lead	$^{209}_{83}$Bi Bismuth	$^{210}_{84}$Po Polonium	$^{210}_{85}$At Astatine	$^{222}_{86}$Rn Radon
$^{223}_{87}$Fr Francium	$^{226}_{88}$Ra Radium	$^{227}_{89}$Ac Actinium															

Key: